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Research Article

Pattern of Admission and Factors Associated with Treatment Outcome of Neonates Admitted in Teaching Hospital in Eastern Ethiopia

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Abstract

Background: Neonatal period is the most vulnerable time for the survival of newborns. Despite many efforts done to improve the outcome of neonates admitted to hospitals; it doesn't show satisfactory progress. The study aimed to assess the pattern, causes of admission, and factors associated with treatment outcomes.

Methods: facility-based cross-sectional study design was conducted among 707 randomly selected neonates from March 1 to 31, 2020. Data were extracted from medical records using a checklist adapted from the national neonatal registration book. The data were inserted into Epi-data version 3.1 and then exported into SPSS window version 22 for analysis. Bivariate and multivariate analyses were done to identify the association between independent variables and the outcome variable.

Results: From 698 admitted neonates during the 2 years period, 594 of them were improved and 104 of them were not improved. Neonatal sepsis, hypothermia, and low birth weight were the leading causes of admission to the hospital. Residency [AOR=2.30, 95%CI: (1.3, 4.12)], low birth weight [AOR=2.52,95%CI:(1.24,5.13))], respiratory distress syndrome [AOR =2.86, 95%CI:(1.11.7.35)], neonatal sepsis [AOR= 2.48, 95%CI: (1.40, 4.38)], and neonates treated with phototherapy and oxygen [AOR=0.22, 95%CI:(0.088,0.54)], [AOR=0.47,95%CI:(0.22,0.99)] were factors associated with poor treatment outcome.

Conclusion: The causes of admission in the study setting were mainly neonatal sepsis, hypothermia, and low birth weight. Residency, low birth weight, respiratory distress syndrome, having neonatal sepsis, treatment with phototherapy, and treatment with oxygen were independent factors. The hospital administrators and staff should strengthen the quality of care provided at the unit and strengthening early detection and prevention of neonatal problems during postpartum periods are means of decreasing poor treatment outcomes.

***Keywords:** Neonate, treatment outcome, causes, NICU*

Introduction

The neonatal period refers to the first 28 days of life. The first 7 days of life is termed as the early neonatal period, while the period between 7 days of life and 28 days is termed as the late neonatal period [1]. The neonatal period is the most vulnerable time for the survival of newborns. Globally, 2.5 million neonates died in 2018. Children continue to face widespread regional problems in their chances of survival. The highest rates of child mortality are still in Sub-Saharan Africa, where 1 child out of 9 children dies before age five and this region is among the regions showing the least progress which accounts for 38 percent of global neonatal deaths [2].

Even though the NICU has advanced technology and trained healthcare professionals to give special care to sick neonates and for those who need specialized nursing care, neonates continue to die [3]. In Ethiopia, neonatal death was declined from 39 deaths per 1000 live births in 2005 to 28 deaths per 1000 live births in 2014. However, a recent report shows a rise in neonatal mortality from 28 deaths per 1000 live births in 2014 to 30 neonatal deaths per 1000 live births in 2019 [4]. This report also indicated that the majority of neonatal deaths occur within the first week of life and requires exceptional efforts and a novel intervention to reduce neonatal deaths as those deaths continue to occur in hospital settings where there are the best neonatal care services.

Even though, Ethiopia has drafted and implemented the national Newborn and Child Survival Strategy (2015-2020) to reduce neonatal death through interventions including neonatal resuscitation, cord care, thermal regulation, Kangaroo Mother Care, antibiotics for neonatal sepsis, and early initiation of breastfeeding by 2020 [5, 6], the country doesn't show good progress in decreasing poor neonatal outcomes. Besides, Ethiopia is striving to achieve SDGs, aiming to end preventable deaths of newborns and children under 5 years of age by 2030 [7]. This warrants a study of factors that influence the poor neonatal outcome in the hospital setting that would help guide clinical practice and policy recommendations to achieve the intended goals as a nation.

Even though there are variations concerning the causes of admission, it is important to identify the causes which are important for the prevention of neonatal morbidity and mortality. Furthermore, it is important to identify influencing factors that would guide the development of focused and evidence-based health interventions to reduce poor neonatal outcomes at the hospital. To our knowledge, this evidence is limited or inadequate, therefore, this study aimed to assess the pattern of admission, causes, and factors associated with treatment outcomes among neonates admitted in Neonatal Intensive Care Unit (NICU) at Hiwot Fana Specialized University Hospital (HFSUH), Harar, Eastern Ethiopia.

Material and Methods

Study Design

An institution-based cross-sectional study design was implemented among 707 randomly selected neonates.

Setting

This study was conducted at the neonatal intensive care unit of Hiwot Fana Specialized University Hospital (HFSUH), in Harar City. The city is located 526 km to the east of Addis Ababa, the capital of Ethiopia. HFSUH currently provides different services for approximately 5.8 million people in the catchment area. The NICU is one of the Intensive Care Unit (ICU) services rendered in the hospital. The hospital admits about 120 neonates per month on average. The unit is divided into a septic room, kangaroo mother care (KMC) room, and critical and subcritical rooms. The unit has 19 neonatal beds and 14 KMC beds, 5 incubators, 10 radiant warmers, and 4 phototherapy machines. Additionally, there are 8 infusers, 4 oxygen cylinders, pulse oximetry, glucometer, and neonatal resuscitation equipment. The unit is staffed with 6 pediatricians, pediatric residents, 4 neonatal nurses, and 7 clinical nurses. The study was conducted from March 1 to March 31, 2020.

Participants

All neonates admitted to the NICU of HFSUH from December 1, 2018, to December 31, 2020, were included in the study. Neonates with incomplete medical records and left against medical advice were excluded from the study (Fig 1).

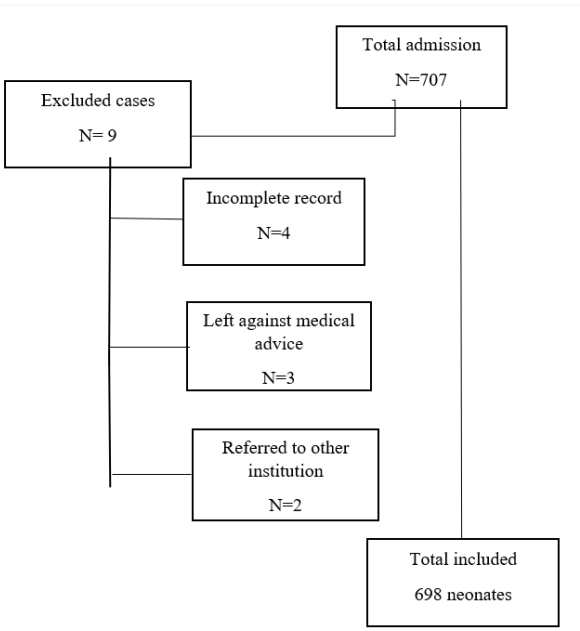

Fig. 1. Flow chart of the inclusion and exclusion criteria.

Sample size determination and sampling procedure

The sample size was calculated by using the single population proportion formula ($n= (Z\alpha/2)^2 p (1-p)/ d^2$) where n is the minimum sample size required, p is the estimated proportion of treatment outcome Zα/2 is the value of the standard score at 95% confidence interval (1.96); with the assumptions of confidence level at 95% = 1.96, a margin of error (d) = 0.03, Non-retrieval rate =10%. For this study p= 18.48% (the proportion of treatment outcome in Jimma medical center, southwest Ethiopia) was used [8] and $n= (1.96)^2*.1848*.8152/ (0.03)^2 = 643$, by adding a 10 % non-response rate, the final sample size became 707. The total number of neonates admitted to NICU from December 1, 2018, to December 31, 2020, was 2536. The sampling frame was prepared for those study populations (admitted neonates) using their Medical Registration Number (MRN) obtained from their medical records. Finally, the study subjects that had been included in the study were identified by using a simple random sampling technique (computer-based) in the sampling frame (N=2536).

Data Collection Methods and Quality assurance

Data were extracted from the medical records of newborns using a checklist adapted from the WHO document of review and audit of neonatal death [1] and the registration book of neonates. We recruited 10 nurses holding BSc degrees and trained them to collect the data, and the primary investigator supervised the process of data collection to ensure quality.

We extracted the age of mother, residence, ANC follow-up, parity, gravidity, neonatal illness, gestational age, birth weight, sex of neonate, APGAR score, treatment provided, treatment outcome, length of stay, place of delivery, and mode of delivery, Antepartum Hemorrhage (APH), postpartum hemorrhage (PPH).

Operational Definitions

Treatment outcome**:** The treatment outcome of admitted neonates was assessed at the time of discharge and categorized as improved and not improved.

Hypothermia: Any low body temperature measurement (<36.5°C) was diagnosed and recorded on charts during the admission of neonates [9].

Prematurity is described as live-born neonates delivered before 37 completed weeks that are already diagnosed by professionals in charge of the admission of the neonate to neonatal intensive care units [10].

Sepsis: Records of infection or sepsis diagnosed either clinically or with culture by professionals during admission of the neonate and recorded on the chart [9].

Birth asphyxia: it is diagnosed whenever a neonate had an Apgar score <6 in the fifth minute, and/or if he/she did not cry immediately after birth; had respiratory distress, floppiness, loss of consciousness, presence of convulsions, and loss of neonatal reflexes [10].

Birth weight is classified using WHO weight classification, low birth weight is any child with birth weight is less than 2,500 g [11]. All other assessments are based on physician judgment as written on the patient card.

Statistical analysis

The data was coded, edited, cleaned, and entered into Epi data statistical software version 3.1 and then exported to SPSS version 20 for analysis. A descriptive statistical analysis was used to summarize the data. The information was presented using frequencies, tables, and figures.

Bivariate analysis and multivariate analysis were done to observe the association between independent variables and the outcome variable by using binary logistic regression. All variables with P≤ 0.25 in the bivariate analysis were included in the final model of multivariate analysis to control all possible confounders. The model goodness of fit was tested by the Hosmer-Lemeshow statistic and omnibus test. The model was considered a good fit since it was found to be insignificant for Hosmer-Lemeshow statistic (p=0.221) and significant for omnibus tests (p=0.000) The multi co-linearity test was carried out to observe the correlation between independent variables using VIF, and standard error, no variables were observed with VIF of >10 and standard error > 2. The direction and strength of statistical associations were measured by the odds ratio with 95% CI. The adjusted odds ratio along with 95% CI was estimated to identify factors for neonatal mortality by using multivariate analysis in the binary logistic regression. In this study P-value < 0.05 was considered to declare a result as a statistically significant association.

Results

Maternal Socio-Demographic Characteristics

A total of 698 admitted neonates during the study period were included for further analysis. The present study shows that more than half 365 (52.3%) of mothers of neonates came from urban areas while 333 (47.7%) were from rural. Maternal age was documented for 612 (87.7%), of which 51 (6.9%) of mothers were below age 20. From 698 mothers, their median age was 27 years with an interquartile range of 10 years.

Obstetrical and neonatal characteristics

There were 269 (38.5%) primiparous mothers and 325 (46.6%) were multiparous mothers. There were 40 (5.7%) mothers with a history of neonatal death. The majority 590 (84.5%) of the neonates were delivered at the hospital while 32 (4.6%) of neonates were delivered at home. Six hundred fifty-seven (94.1%) of neonates were born within 24 hours of the start of labor. Almost one-third (30.7%) of mothers experience an obstetrical complication during labor and delivery. The most common obstetrical complications were eclampsia 49 (23%), hemorrhage 47 (22.1%), prolonged labor 47 (22%), sepsis 34 (16%), and obstructed labor 22 (10.3%).

Three hundred eighty-four (55%) neonates were males. More than two-thirds (69.1%) of neonates were admitted within 24 hours of life. The median age at admission was 9.5 hours with an interquartile range of 71 hours. Most 660 (80.4%) of neonates stayed at the hospital for less than 7 days. The median hospital stay was 72 hours with an interquartile range of 120 hours. APGAR score was documented for 674 (82.1%) neonates. Out of those, a low APGAR score was recorded for 129 (19.1%) and 24 (3.6%) of neonates in the 1st and 5th minute, respectively. Birth weight was documented for 613 (87.8%) neonates. Among those, one hundred eighty-six (30.3%) neonates were low birth weight, 39 (6.4%) neonates were very low birth weight, and 2 (0.3%) neonates were extremely very low birth weight (Table 1).

Table 1: Characteristics of neonates admitted to HFSUH, Harar, Ethiopia, 2020.

Variable	Category	Frequency	Percentage
Sex of neonate (n=698)	Male	384	55
	Female	314	45
Age of neonates (n=698)	<24 hours	402	57.6
	24-168 hours	186	26.6
	≥168 hours	110	15.8
Birth weight recorded (n=698)	Yes	613	87.8
	No	85	12.2
Birth weight (n=613)	Normal	361	58.9
	LBW	186	30.3
	VLBW	39	6.4
	EVLBW	2	0.3
	Macrosomia	25	4.1
APGAR score documented (n=698)	Yes	572	81.9
	No	126	18.1
APGAR score on 1st minute (n=572)	Low Moderate	94	16.4
		234	40.9
	Normal	244	42.7
APGAR score on 5th minute (n=572)	Low	8	1,4
	Moderate	169	29.5
	Normal	395	67.1
Length of stay at hospital (n=698)	<7days	576	82.5
	≥7days	122	17.5
Gestational age (n=698)	Preterm	198	28.4
	Term	500	71.6

LBW=Low Birth weight, VLBW=Very Low Birth Weight, EVLBW=Extreme Very Low Birth Weight, APGAR= Appearance Pulse Grimace Activity Respiration.

Causes of Admission

More than half (387,55.4%) of admissions were due to neonatal sepsis. Of those,62 died, accounting for 51 % of total neonatal mortality. On the other hand, hypothermia accounts for 251 (36%) of admissions. Low birth weight was the third cause of admission to NICU, 35.2% and 50% of neonatal admissions and deaths, respectively (Table 2).

Table 2: Common causes of neonatal admission to NICU of HFSUH, Harar, Ethiopia, 2020 (n=698).

Variable	Category	Frequency	Percentage
Prematurity	Yes	198	28.4
	No	500	71.6
Low birth weight	Yes	246	35.2
	No	452	64.8
Neonatal sepsis	Yes	387	55.4
	No	311	44.6
Congenital malformations	Yes	32	4.6
	No	666	95.4
Respiratory distress syndrome	Yes	34	4.9
	No	664	95.1
Perinatal asphyxia	Yes	163	23.4
	No	535	76.6
Hypothermia	Yes	251	36
	No	447	64
Hypoglycemia	Yes	98	14
	No	600	86
Pathologic jaundice	Yes	53	7.6
	No	645	92.4
Meconium aspiration syndrome	Yes	73	10.5
	No	625	89.5
Hemorrhagic diseases of newborn	Yes	28	4
	No	670	96
Birth trauma	Yes	18	2.6
	No	680	97.4
Others	Yes	50	7.2
	No	648	92.8

*Others: Anemia, Necrotizing enterocolitis, Impetigo, Shock, and Neonatal seizure.

Treatment modality

Antibiotics were given to more than half 485 (69.5%) of admitted neonates. The most frequently administered one was a combination of ampicillin and gentamycin 346 (71.3%). Other combinations were found to be ampicillin with ceftriaxone 54 (11.1%) and vancomycin with cefotaxime 31 (6.4%). Oxygen and glucose were administered for 437 (62.6%) and 392 (56.2%) neonates, respectively (Figure 2).

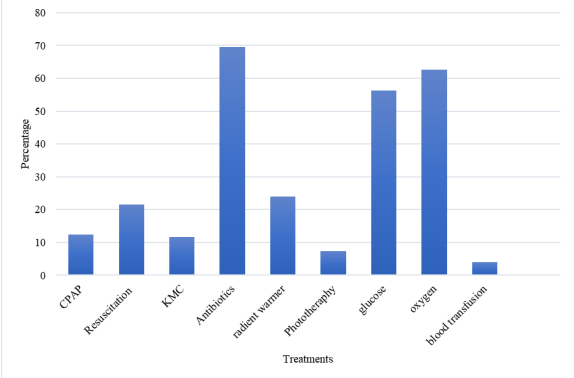

Fig. 2. Treatment provided for neonates admitted at NICU of HFSUH, Harar, Ethiopia, 2020.

Treatment Outcome of Neonates

From a total of 698 admitted neonates during the two years, 594 of them were improved, 104 neonates' status was not improved. Neonatal sepsis (51%), low birth weight (49%), and prematurity (42.3%) were identified as leading causes of neonatal death. Other causes of neonatal death include perinatal asphyxia 43 (41.3%), multi-organ failure 25 (24%), and respiratory failure 15 (14%).

Pattern of neonatal mortality

More than three-fourths of the deaths (76, 73%) occurred within the first 24 hours of age and 11% of deaths occurs within 72 hours of age. The death pattern declined as the age of the child crossed 72 hours (Figure 3).

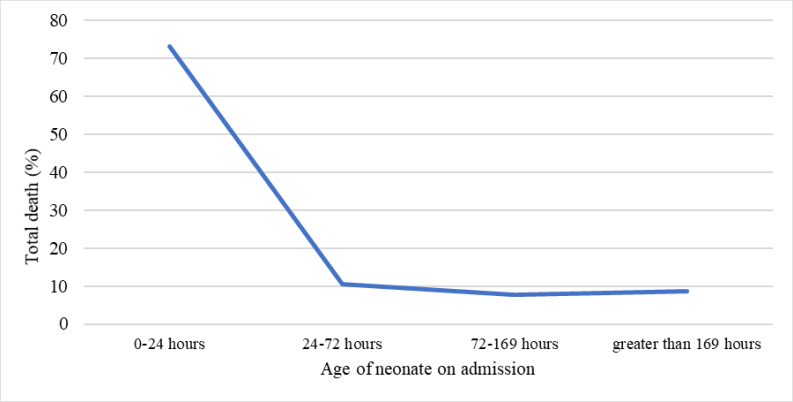

Fig. 3. Pattern of neonatal mortality among neonates admitted to HFSUH, Harar, eastern Ethiopia, 2020.

Factors Associated with Treatment Outcome of Admitted Neonates

In multivariate analysis variables including residency, presence of ANC follow-up, complications during labor and delivery, place of delivery, APGAR score on 1st minute, prematurity, LBW, neonatal sepsis, RDS, neonatal resuscitation, phototherapy, oxygen, and glucose were included. Residency, LBW, neonatal sepsis, RDS, phototherapy, and oxygen were significantly associated with treatment outcomes.

The multivariable analysis showed that the odds of poor treatment outcomes among mothers of neonates who come from the rural area were 2.3 times higher than that of mothers of neonates who come from the urban area [AOR=2.30, 95%CI: (1.3, 4.12)]. The odds of poor treatment outcome among newborns who had low birth weight were 2.5 times that of neonates who did not have the condition [AOR=2.52, 95%CI: (1.24,5.13))]. Neonates with a diagnosis of respiratory distress had 2.86 times higher odds of poor treatment outcome compared to those neonates without RDS [AOR =2.86, 95%CI:(1.11.7.35)]. The odds of poor treatment outcome among neonates who had neonatal sepsis were 2.48 times that of neonates who did not have the condition [AOR= 2.48, 95%CI: (1.40, 4.38)]. Neonates treated with phototherapy and oxygen had 0.22, and 0.47 times less likely to have poor treatment outcome than neonates without those conditions [AOR=0.22, 95% CI:(0.088,0.54)], [AOR= 0.47,95%CI:(0.22,0.99)] respectively (Table 3).

Table 3: Factors associated with treatment outcome at Hiwot Fana Specialized University Hospital, Harar, Ethiopia, 2020 (n=698)

Variables		Treatment outcome			
		Improved	Died	COR (95% CI)	AOR (95%CI)
Residency	Urban	303	30	1	1
	Rural	291	74	2.57(1.63,4.04) **	2.30(1.3, 4.12) *
ANC follow-up	Yes	451	66	1	1
	No	143	38	1.82 (1.17,2.81) *	1.24(0.70, 2.21)
Complication during labor and delivery	No	429	55	1	1
	Yes	165	49	2.32(1.52,3.54) **	1.70(0.90,2.88)
APGAR score on 1st minute	Reassuring	221	23	1	1
	Moderate	193	41	2.04(1.44,5.28)	1.55(0.83,2.88)
	Low	73	21	2.76 (1.18,3.52) *	2.03(0.87,4.77)

Table continued...

Prematurity	No	448	52	1	1
	Yes	146	52	3.07(2.01,4.70) **	1.10(0.53,2.28)
LBW	No	414	38	1	1
	Yes	180	66	4.0(2.60,6.2) **	2.52(1.24,5.13) *
Sepsis	No	273	38	1	1
	Yes	321	66	1.48 (1.07,2.6)	2.48(1.40, 4.38) *
RDS	No	572	92	1	1
	Yes	22	12	3.4(1.61,7.10) **	2.86(1.11.7.35) *
Resuscitation	Yes	118	32	1	
	No	476	72	0.56(0.35,0.88) *	0.61(0.311,1.81)
Phototherapy	Yes	37	14	1	1
	No	557	90	0.43(0.22,0.82) *	0.22(0.088,0.54) **
Oxygen	Yes	353	84	1	1
	No	241	20	0.35(0.21,0.58) **	0.47(0.22,0.99) *
Glucose	Yes	312	80	1	
	No	282	24	0.33(0.21,0.54) **	0.69(0.35,1.35)

*Significant with P <0.05 and ** Significant with P<0.001, CI= Confidence Interval, COR= Crude Odds Ratio, AOR= Adjusted Odds ratio, APGAR: Appearance Pulse Grimace Activity Respiration; LBW: Low Birth Weight; RDS Respiratory Distress Syndrome.

Discussion

Despite the establishment of NICU for improving the life of newborns, most of the hospital's NICU organization lacks the necessary drugs and is not well equipped in which poor neonatal outcome remains to occur in those settings in Ethiopia. Therefore, we have tried to show the pattern, cause, and treatment outcome in the hospital setting. Additionally, we have tried to isolate factors that influence treatment outcomes at a tertiary hospital in Ethiopia. Accordingly, we have observed that residency, LBW, RDS, sepsis, treatment with phototherapy, and oxygen were factors that significantly associated with treatment outcome in multivariable logistic regression analysis.

The present study reported that neonatal sepsis, hypothermia, and low birth weight were the predominant causes of neonatal admission. Neonatal sepsis accounts for 55.4% of admissions and 51% of neonatal deaths. Neonatal sepsis was found to be within the top three leading causes of neonatal admission in several studies [10, 12-14]. This study implied that there is a clear gap in the management and prevention of sepsis. Similarly in this study, 49% of neonates in this study had LBW and 35.5% of death was due to LBW, which is in line with the study done in Gondar [10] and Jimma [12] and Mekele [15]. This implies that the majority of causes of neonatal admissions were attributed to preventable and treatable neonatal conditions and can be prevented if care providers practice evidence-based interventions.

In this study, mothers of neonates who came from rural areas had 2.3 times higher risk of poor treatment outcomes. This is consistent with a study conducted in Jimma [12]. This may be due to the delay in deciding to seek care and delay in reaching health care services which would affect the on-time arrival of laboring mothers to the hospital and lead to the occurrence of obstetrical complications and then the occurrence of neonatal diseases. In this study, the odds of death among newborns who had low birth weight were 2.5 times that of neonates who did not have the condition. This is consistent with studies done in Brazil, Guinea-Bissau, Eritrea, and Jimma, Ethiopia [12, 16-18]. The possible justification is that low birth weight has immaturity of the immune system and other body defense mechanisms that control newborn disease susceptibility [19]. Then the neonates may develop health problems including RDS, bleeding from the brain, NEC, and finally, poor neonatal outcomes may follow.

Neonates having RDS had 2.86 times higher odds of poor treatment outcomes compared to those neonates without RDS. This is consistent with studies conducted in Mexico, Ghana, and Jimma [10, 20, 21]. The possible justification is that RDS causes air leaks, intracranial bleeding, pulmonary hemorrhage, bronchopulmonary dysplasia, retinopathy of prematurity, and finally leads to poor treatment outcome [19]. The odds of poor treatment outcome among neonates who had neonatal sepsis were 2.48 times that of neonates who did not have the condition. This is consistent with studies conducted in Ghana, Gondar, and Mekele, Ethiopia [10, 15, 20, 22]. The possible justification is that sepsis results in abscess formation, venous thrombosis, neurologic damage, and multiorgan dysfunction [23].

Our findings in the present study also indicated that poor treatment outcome was also inversely related to treatment with phototherapy and oxygen. that treatment with oxygen and phototherapy can cure neonatal jaundice and other neonatal illness, then decreases the chance of poor treatment outcomes [19].

Strength and Limitation of the study

This study tried to assess multiple factors that affect the treatment outcome of neonates admitted to the NICU of HFSUH. The limitation of this study was it might not indicate a cause-effect relationship because the study design was cross-sectional. The use of medical records of newborns because of incompleteness and since the study is institution-based, the results might lack generalization to the entire population in the catchment area.

Conclusion

The study revealed that the causes of NICU admission were neonatal sepsis, hypothermia, and low birth weight. Residency, low birth weight, respiratory distress syndrome, having neonatal sepsis treated with phototherapy, and being treated with oxygen were independent factors. Most neonatal complications are due to preventable and treatable conditions. Health care providers, hospital management should work hard to improve care for all neonates with special attention to the care of high-risk neonates and should focus on factors that affect neonatal survival to reduce neonatal mortality.

Abbreviations

ANC: Antenatal Care; APGAR: Appearance Pulse Grimace Activity Respiration; HFSUH: Hiwot Fana Specialized University Hospital; LBW: Low Birth Weight, NICU: Neonatal Intensive Care Unit; RDS: Respiratory Destress Syndrome.

Declarations

Ethics approval and consent to participate

Ethical clearance was secured from Haramaya University, College of Health and Medical Sciences, Institutional Health Research Ethics Review Committee (IHRERC). Informed, voluntary, written, and signed consent was obtained from hospital administrators before the data collection.

Since the study was based on secondary data, there was no direct contact with patients. Therefore, anonymity was maintained by using the identified number instead of the patient's name. Besides, all data abstracted was kept confidential and not used for any other purpose than the stated objective and all methods were carried out per ethical guidelines.

Data sharing statement

There are no additional unpublished data from this study that are available.

Conflict of interest

There is no conflict of interest

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Contributions of the authors

AE, the corresponding author, worked on designing the study, trained and supervised the data collectors, checked the completeness of the collected data, entered, analyzed, and interpreted the results, and prepared the manuscript. The co-author, namely TG played his role in re-analyzing and writing the final draft of the results. Moreover, the co-author wrote the manuscript. The author was involved in reading and approving the final manuscript.

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